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Project Clean DronHy: a two-stage metal hydride compressor based on commercial alloys

J. Barale[1]*, F. Nastro[2], P. Rizzi[1], C. Luetto[2], M. Baricco[1]
[1] Department of Chemistry and Inter-departmental Center Nanostructured Interfaces and Surfaces (NIS) - INSTM, University of Turin, Via P. Giuria 7, 10125 Torino, (Italy).
[2] Tecnodelta S.r.l., Via Francesco Parigi 5H, 10034 Chivasso (To), (Italy)

Corresponding Author e-mail: jussara.barale@unito.it
*lead presenter e-mail: jussara.barale@unito.it

In the framework of the Clean-DronHy project, supported by Regione Piemonte (Italy), a drone driven by H_2 has been realized, with ~ 70 min of autonomy.
In parallel, a H_2 refueling station (H2RS) has been developed, in which H_2 is produced by an electrolyzer (EL), driven by photovoltaic panels. Afterwards, it is compressed by a two-stage metal hydride-compressor (MH-C) and a booster. In details, the EL produces H_2 at 30 bar, that is directly compress up to 250 bar by the MH-C. Then, it can fill the drone bottle at 200 bar or it can be further compressed up to 300 bar by a commercial booster. The drone uses a type IV bottle of 3 l. In this work, results related to the MH-C performances are presented.
The use of MH to compress H_2 is an innovative technology [1], that exploits the thermodynamics of the reversible reaction between H_2 and a metal compound (M). Compression occurs since M can absorb H_2 at low pressure and temperature (T_{low}), forming a metal hydride (MH). Then, heating up the MH at the so-called T_{high}, H_2 is released at sensitively higher pressure.
To realize the MH-C, a materials selection has been carried out. A $(LaCe)Ni_5$-alloys is selected for the 1st stage, and the Hydralloy-C5 ($TiMn_2$-based alloy) for the 2nd one. About 700 - 800 g of two commercial alloys have been located in each reactor. The MH-C works between 30 °C and 150 °C, exploiting an average flow of 85 Nl/h in filling the 3 l bottle at 200 bar. While coupling the MH-C with the booster, an average flow of 151 Nl/h was achieved, filling the cylinder at 300 bar. The MH-C has a rather low power consumption (~ 600 W) and can be easily integrated with the booster and the EL.

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References
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